

January 27, 1975

**—FEDERAL STANDARD 376B—**

Supersedes Fed. Std. 376A, May 5, 1983

**PREFERRED  
METRIC UNITS  
FOR  
GENERAL USE  
BY THE  
FEDERAL**

---

---

**General Services Administration**

## Foreword

This standard was developed by the Standards and Metric Practices Subcommittee of the Metrication Operating Committee, which operates under the Interagency Council on Metric Policy. It is the basic Federal standard that lists metric units recommended for use throughout the Federal government, and is specified in the *Federal Standardization Handbook*, issued by the General Services Administration in accordance with 41 CFR 101-29. Before issue, it was coordinated with the departments and agencies of the Interagency Council on Metric Policy.

The General Services Administration has authorized the use of this Federal standard by all Federal agencies.

### **Civilian Agency Coordinating Activity:**

Federal Supply Service, General Services Administration

### **Military Agency Coordinating Activity:**

Standardization Program, Office of the Assistant Secretary  
(Production and Logistics), Department of Defense

### **Preparing Activity:**

Metric Program, National Institute of Standards and Technology,  
Technology Administration, Department of Commerce

## Changes

When a federal agency determines that there is a need for a revision of this standard, a written request for revision should be submitted to the General Services Administration, Federal Supply Service, Environmental and Engineering Policy Division (FCRE), Washington, DC 20406. The request shall include data that support the proposed change. The Metric Program, National Institute of Standards and Technology, as custodian of this standard, will coordinate all proposed changes with the Metrication Operating Committee.

## Table of Contents

1. Scope . . . . .	1
2. Authoritative Document . . . . .	1
3. Definitions . . . . .	1
4. General Requirements . . . . .	1
5. Detailed Requirements . . . . .	8
Bibliography . . . . .	20
Alphabetical Index . . . . .	21

## 1. SCOPE

This standard lists preferred metric units (See 4.1) recommended for use throughout the Federal Government. It gives guidance on the selection of metric units required to comply with the provisions of the Metric Conversion Act of 1975 (P.L. 94-168), as amended by the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418), and Executive Order (EO) 12770 of July 25, 1991. The guidance in this standard applies to, but is not limited to, the drafting of laws, regulations, contracts, and purchase orders; and the preparation of reports, statistical tables, and databases.

## 2. AUTHORITATIVE DOCUMENT

The following document forms the authoritative basis of this standard to the extent specified herein:

*American National Standard for Metric Practice*, ANSI/IEEE Std 268-1992,  
Institute of Electrical and Electronics Engineers, Inc.

## 3. DEFINITIONS

- 3.1 **SI Units.** Units belonging to the International System of Units, which is abbreviated SI (from the French *Le Système International d'Unités*), as interpreted or modified for use in the United States by the Secretary of Commerce (55 F.R. 52242, Dec. 20, 1990).
- 3.2 **Inch-pound Units.** Units based upon the yard and the pound, commonly used in the United States, and defined by the National Bureau of Standards (now the National Institute of Standards and Technology). In this standard, the term inch-pound unit includes other customary units, such as the degree Fahrenheit, used extensively in the United States at present. Some inch-pound units used in the United States, such as the gallon, have the same name as units previously used in other countries but differ in magnitude.

## 4. GENERAL REQUIREMENTS

- 4.1 **Preferred Metric Units.** Preferred metric units for use throughout the Federal Government are:

The SI units (together with their multiples and submultiples);

Three other metric units—the liter, hectare, and metric ton—that are accepted for use with

the SI units because of their practical importance; and

A small number of other metric units, listed in Section 5, that are accepted because of their use in specialized fields.

The preferred metric units listed in Section 5 of this standard have been selected in accordance with the recommendations of ANSI/IEEE Std 268.

**4.1.1 SI Base Units and Supplementary Units.** The SI is constructed from seven base units for independent quantities<sup>1</sup> plus the two supplementary units for plane angle and solid angle.

<u>Quantity</u>	<u>Unit Name</u>	<u>Unit Symbol</u>
length	meter	m
mass <sup>2</sup>	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd
plane angle	radian	rad
solid angle	steradian	sr

**4.1.2 SI Derived Units.** Derived units are formed by combining base units, supplementary units, and other derived units according to the algebraic relations linking the corresponding quantities. The symbols for derived units are obtained by means of the mathematical signs for multiplication, division, and use of exponents. For example, the SI unit for velocity is the *meter per second* (m/s or  $\text{m} \cdot \text{s}^{-1}$ ), and that for angular velocity is the *radian per second* (rad/s or  $\text{rad} \cdot \text{s}^{-1}$ ). Some derived SI units have been given special names and symbols, as follows:

---

<sup>1</sup> As used in this standard, "quantity" is the technical word for measurable attributes of phenomena or matter.

<sup>2</sup> In commercial and everyday use, and in many technical fields, the term "weight" is usually used as a synonym for mass. This is how "weight" is used in most United States laws and regulations. See the note at 5.2.1 for further explanation.

<u>Quantity</u>	<u>Unit Name</u>	<u>Unit Symbol</u>	<u>Expression in Terms of Other SI Units</u>
Absorbed dose, specific energy imparted, kerma, absorbed dose index	gray	Gy	J/kg
Activity (of a radionuclide)	becquerel	Bq	1/s
Celsius temperature	degree Celsius	°C	K
Dose equivalent	sievert	Sv	J/kg
Electric capacitance	farad	F	C/V
Electric charge, quantity of electricity	coulomb	C	A·s
Electric conductance	siemens	S	A/V
Electric inductance	henry	H	Wb/A
Electric potential, potential difference, electromotive force	volt	V	W/A
Electric resistance	ohm	Ω	V/A
Energy, work, quantity of heat	joule	J	N·m
Force	newton	N	kg·m/s <sup>2</sup>
Frequency (of a periodic phenomenon)	hertz	Hz	1/s
Illuminance	lux	lx	lm/m <sup>2</sup>
Luminous flux	lumen	lm	cd·sr
Magnetic flux	weber	Wb	V·s
Magnetic flux density	tesla	T	Wb/m <sup>2</sup>
Power, radiant flux	watt	W	J/s
Pressure, stress	pascal	Pa	N/m <sup>2</sup>

4.1.3 **SI Prefixes.** The common metric prefixes are:

<u>Multiplication Factor</u>	<u>Prefix Name</u>	<u>Prefix Symbol</u>
1 000 000 000 000 = 10 <sup>12</sup>	tera	T
1 000 000 000 = 10 <sup>9</sup>	giga	G
1 000 000 = 10 <sup>6</sup>	mega	M
1 000 = 10 <sup>3</sup>	kilo	k
100 = 10 <sup>2</sup>	hecto	h
10 = 10 <sup>1</sup>	deka	da
0.1 = 10 <sup>-1</sup>	deci	d
0.01 = 10 <sup>-2</sup>	centi	c
0.001 = 10 <sup>-3</sup>	milli	m
0.000 001 = 10 <sup>-6</sup>	micro	μ
0.000 000 001 = 10 <sup>-9</sup>	nano	n
0.000 000 000 001 = 10 <sup>-12</sup>	pico	p

These prefixes are part of SI. They are attached to an SI unit name or symbol to form what are properly called "multiples" and "submultiples" of the SI unit. Prefixes produce units that are of an appropriate size for the application, e.g., millimeter or kilometer. Examples that show reasonable choices of multiples and submultiples for many practical applications are given in Section 5. While all combinations are technically correct, many are not used in practice. The prefixes deci, deka, and hecto are rarely used; prefixes that are multiples or submultiples of 1000 are generally preferred. When the unit name is written in full, the prefix is written in full: megahertz, not Mhertz. When the unit symbol is used, the prefix symbol is used: MHz, not megaHz. Only one prefix should be used in forming a multiple of an SI unit, e.g., Mg, not kkg; or  $\mu\text{V}$ , not mmV. Prefix symbols for the values a million or greater are capitalized and those below a million are written in lower case.

**4.1.4 Editorial Style.** The names of all SI units begin with a lower case letter except, of course, at the beginning of a sentence or when other grammar rules dictate capitalizing nouns. There is one exception: in "degree Celsius" the term "degree" is lower case but "Celsius" is always capitalized. Unit symbols are always written in lower case except for the liter and those units derived from the name of a person (e.g., W for watt, Pa for pascal, etc.). SI symbols are unique "letter shorthand" for unit names—they are not abbreviations and should therefore not be followed by a period (except at the end of a sentence). Likewise, symbols stand for both the singular and plural of the unit and should not have an "s" added. SI units are always written in an upright typeface with a space between the numeric value and the symbol. See ANSI/IEEE Std 268 and other documents listed in the Bibliography for further usage rules.

**4.2 Accepted Units.** For practical reasons a number of non-metric units are accepted for use. These include units of time (minute, hour, etc.), units of plane angle (degree, etc.), and a few units for special applications, such as the nautical mile, used in navigation. Section 5 includes accepted units and shows their areas of application. These units may be used in full compliance with the provisions of the amended Metric Conversion Act, EO 12770, and the **Federal Register** Notice, "Metric System of Measurement; Interpretation of the International System of Units for the United States" (55 F.R. 52242, Dec. 20, 1990).

**4.3 Unacceptable Metric Units.** Many older metric practices do not comply with the amended Metric Conversion Act, EO 12770, and 55 F.R. 52242. Particular care shall be taken to avoid introducing non-SI practices into the United States in areas where such practices are not now established. The units listed in the following three subsections shall not be used.

**4.3.1 CGS Units.** Units with special names peculiar to the various cgs (centimeter-gram-second) systems shall not be used. Among these units are the following that have been commonly used:

erg, dyne, gal	used in mechanics;
poise, stokes	used in fluid dynamics;
stilb, phot, lambert	used in photometry;
emu, esu, gauss, oersted, maxwell, gilbert, biot, franklin, abampere, abvolt, statvolt, etc.	} used in electricity and magnetism.

**4.3.2 Deprecated Names or Symbols.** Other units from older versions of the metric system and metric jargon that shall not be used include:

<u>Incorrect term</u>	<u>Correct Unit</u>
kilo	kilogram
are	square dekameter
candle or candlepower	candela
fermi	femtometer
gamma	nanotesla
micron	micrometer
millimicron	nanometer
mho	siemens
$\gamma$	microgram
$\lambda$	cubic millimeter or microliter

**4.3.3 Miscellaneous Non-SI Units Not to be Used.** Additional units that are not accepted for use include the following:

ångström  
calorie  
 $g$  as a unit of acceleration ( $g = 9.81 \text{ m/s}^2$ )  
grade or gon [1 grade =  $(\pi/200)$  rad]  
kilogram-force  
langley (1 langley =  $1 \text{ cal/cm}^2$ )  
metric carat  
metric horsepower  
millimeter of mercury  
millimeter, centimeter, or meter of water  
standard atmosphere (101.325 kPa)  
technical atmosphere (98.0665 kPa)  
torr (133.322 Pa)

4.4 **Conversion.** Conversion factors in Section 5 are shown from inch-pound units to metric units, generally to seven significant digits. The first column, labeled **From**, lists inch-pound and other units commonly used to express the quantities; the second column, labeled **To**, gives SI units or other preferred units; and the third column, labeled **Multiply By**, gives the conversion factors by which the numerical value in **From** units must be multiplied to obtain the numerical value in **To** units. For conversion from inch-pound units to metric units, multiply by the factor. For example, to convert 10.1 feet to meters multiply by 0.3048; the answer is 3.078 meters, which can be rounded to 3.08 meters (see Section 4.5 on rounding). For conversion from metric units to inch-pound units, divide rather than multiply by the factor. For example, to convert 16.3 meters to yards divide by 0.9144; the answer is 17.826 yards, which can be rounded to 17.8 yards.

4.5 **Rounding.** For rounding of metric values obtained by conversion from inch-pound values, the following simplified rules are suggested. A more complete treatment of rounding rules is given in Appendix C of ANSI/IEEE Std 268.

4.5.1 If the inch-pound value is expressed by a combination of units such as feet and inches, or pounds and ounces, it should first be converted to the smaller unit.

Examples:      12 ft 5 in = 149 in  
                    1 lb 3-1/2 oz = 19.5 oz

4.5.2 Multiply the inch-pound value by the conversion factor. If the first significant<sup>3</sup> digit of the metric value is equal to or greater than the first significant digit of the inch-pound value, round the metric value to the same number of significant digits as there are in the inch-pound value.

Examples:      11 mi x 1.609 = 17.699 km, which rounds to 18 km  
                    61 mi x 1.609 = 98.149 km, which rounds to 98 km

If the first significant digit of the metric value is smaller than the first significant digit of the inch-pound value, round to one more significant digit.

Examples:      66 mi x 1.609 = 106.194 km, which rounds to 106 km  
                    8 ft x 0.3048 = 2.4384 m, which rounds to 2.4 m

---

<sup>3</sup>One or more zeroes at the beginning of a number are not treated as significant.

4.5.3 When the digits to be discarded begin with a 5 or more, increase the last digit retained by one.

Example: 8.3745, if rounded to three digits, would be 8.37; if rounded to four digits, would be 8.375.

4.5.4 It is essential to use good judgment in estimating the precision required in conversions.

Example: A length given as 8 ft would ordinarily convert to 2.4 m. If, however, the measurement given as 8 ft is believed to be valid to the nearest 1/10 inch, it should be treated as 8.00 feet and considered as having three significant digits. The rounded dimension would then be 2.438 m instead of 2.4 m.

Do not retain more digits than is appropriate for the situation.

Example: A nautical chart shows a landmark to be 75 ft in height; from subsection 4.5.2 this rounds to 22.8 m, but a value of 23 m would be more reasonable for the application.

4.5.5 Where an inch-pound value represents a maximum or minimum limit that must be respected, the rounding must be in the direction that does not violate the original limit.

Example: For most applications 10 ft rounds to 3 m, but if a safety code requires 10 feet of clearance from a high voltage line, a conversion to 3.05 meters must be used until new studies show 3 meters of clearance to be sufficient.

4.5.6 Normally, temperatures expressed in a whole number of degrees Fahrenheit should be converted to the nearest 0.5 K (or degree Celsius). As with other quantities, the number of significant digits to retain will depend upon the implied accuracy of the original temperature.

## 5. DETAILED REQUIREMENTS

This section gives detailed requirements for the selection of units, consistent with ANSI/IEEE Std 268. The subsections list conversion factors to the appropriately sized metric unit, either an SI unit with appropriate prefix or a non-SI unit that is accepted for use with SI. ANSI/IEEE Std 268, which has been recommended by the Metrication Operating Committee of the Interagency Council on Metric Policy for use by all agencies and departments of the Federal Government, lists conversion factors to SI units only. The SI units are the coherent set of base, supplementary, and derived units without prefixes, except for the base unit kilogram.

Government agencies may develop supplemental lists of accepted units applicable to their special fields. Such supplemental lists shall be consistent with this Federal Standard and with ANSI/IEEE Std 268.

**Other Derived Quantities.** It is not practical to list all quantities, but others not listed can be readily derived using the conversion factors given. For example, to convert from inches per second to centimeters per second, multiply by 2.54; to convert from Btu per pound to joules per kilogram, multiply by  $(1055.056)/(0.45359237)$  or 2326.

**Note on Mixed Units and Fractions.** Mixed units, which are commonly used with inch-pound units, are not used in metric practice. Thus, while a distance may be given in inch-pound units as 27 ft, 5 in, metric practice shows a length as 3.45 m rather than 3 m, 45 cm. Binary fractions (such as 1/2 or 3/8) are not used with metric units. For example, a person's weight is given as 70.5 kg, not 70-1/2 kg.

Preferred units for various quantities are grouped in the following subsections by: Space and Time, Mechanics, Heat, Electricity and Magnetism, Light, and Radiology. (These groupings are consistent with the groupings in ANSI/IEEE Std 268.) The quantities under each group are listed in italic type. The first column, labeled **From**, lists inch-pound and other units commonly used to express the quantities; the second column, labeled **To**, gives SI units or other preferred units; and the third column, labeled **Multiply By**, gives the conversion factors (generally to seven significant digits) by which the numerical value in **From** units must be multiplied to obtain the numerical value in **To** units. SI units and their submultiples or multiples, in the **To** column, are in bold type. The liter, hectare, and metric ton and other accepted units (see 4.2), in the **To** column, are in normal type. Conversion factors, in the **Multiply By** column, that are exact are in bold type.